MILD HYPERCAPNIA CAUSES A MEASURABLE CHANGE IN CEREBRAL OXYGEN EXTRACTION FRACTION
(OEF)

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TARGET AUDIENCE: Physicians, Researchers and scientists interested in stroke Imaging
PURPOSE: Oxygen Extraction Fraction (OEF) is a key perfusion marker and shown to be an independent predictor of stroke\(^1\). We described an MRI technique using PARSE for quantifying OEF previously\(^2\). Here we show that we can measure dynamic changes in OEF (OEF Reactivity) by inducing mild hypercapnia using a breath-hold experiment. This surrogate measure for cerebrovascular reserve provides complementary information on collateralization, and correlates with favorable outcomes in revascularization therapy.

METHODS: A Parameter Assessment by Retrieval from Signal Encoding (PARSE) \(^3\) based MR-OEF sequence was implemented (Reported in Abstract \#6354) on a clinical 3T MR scanner (Fig 1). In a series of 5 normal volunteers (M/F 3/2, <age> = 26 ±10 years) we acquired single slice, 5.0 mm thick, 220 mm x 220 mm FOV, 64 x 64 matrix, resolution = 3 x 3 x 5.0 mm\(^3\)) 2D PARSE images. Volunteers were tested with 4 conditions: normal breathing, breath-hold at the 1\(^{st}\), 5\(^{th}\) and 10\(^{th}\) measurement. PARSE acquisitions were taken every 3 seconds through the breath-hold, for a total of 20 measurements. The frequency change maps were calculated from PARSE reconstructions. Spatial ICA analysis was then performed on these frequency maps to separate out other confounding static effects from the dynamic OEF components.

RESULTS: The change in OEF following a breath-hold experiment is seen in the representative fractional OEF difference maps (Figure 2). The OEF reactivity for different breath-hold conditions is shown in Figure 3. OEF reactivity is seen soon after the breath-hold induced physiologic stress.

DISCUSSION/CONCLUSION: While the free-breathing condition \(\Delta OEF\) does not change measurably, the mild hypercapnic conditions do cause a measurable change in \(\Delta OEF\). This technique can provide supplemental information regarding the vascular reserve in patients who typically receive diamox/acetazolamide challenge to determine information on collateralization. The speed of the MR-OEF technique allows for multiple measurements in a single breath-hold experiment thus allowing measurement of dynamic OEF changes. Clinical validation of this technique on patients needs to be done to establish the efficacy of this technique.


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